

MLLNVLRICI	IVCLVNDGAG	KHSEGRERTK	TYSLNSRGYF	40
RKERGARRSK	ILLVNTKGLD	EPHIGHGDFG	LVAELFDSTR	80
THTNRKEPDM	NKVLFSTVA	HGNKSARRKA	YNGSRRNIFS	120
RRSFDKRNTE	VTEKPGAKMF	WNNFLVKMNG	APQNTSHGSK	160
AQEIMKEACK	TLPFTQNIVH	ENCDRMVIQN	NLCFGKCISL	200
HVPNQQDRRN	TCSHCLPSKF	TLNHLTLNCT	GSKNVVKVVM	240
MVEECTCEAH	KSNFHQTAQF	NMDTSTTLHH		270

Figure 1. Deduced amino acid sequence of *Xenopus cerberus* protein. SEQ ID NO:1.

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Figure 2. Nucleotide sequence of the full-length cerberus DNA derived from the Xenopus organizer. The sense strand is on top (in the 5' to 3' direction) and the antisense strand on the bottom line (on the opposite direction). SEQ ID NO:2.

GAATCCCAG CAAGTCGCTC AGAAACACTG CAGGGTCTAG ATATCATACA ATGTTACTAA 60
CTTAAGGGTC GTTCAGCGAG TCTTTGTGAC GTCCAGATC TATAGTATGT TACAATGATT

ATGTACTCAG GATCTGTATT ATCGTCTGCC TTGTGAATGA TGGAGCAGGA AAACACTCAG 120
TACATGAGTC CTAGACATAA TAGCAGACGG AACACTTACT ACCTCGTCCT TTTGTGAGTC

AAGGACGAGA AAGGACAAAA ACATATTCAC TTAACAGCAG AGGTTACTTC AGAAAAGAAA 180
TTCCTGCTCT TTCCTGTTTT TGTATAAGTG AATTGTCGTC TCCAATGAAG TCTTTTCTTT

GAGGACGACG TAGGAGCAAG ATTCTGCTGG TGAATACTAA AGGTCTTGAT GAACCCACAC 240
CTCCTCGTGC ATCCTCGTTC TAAGACGACC ACTTATGATT TCCAGAATA CTGGGGTGT

TTGGGCATGG TGATTTTCGC TTAGTAGCTG AACTATTTGA TTCCACCAGA ACACATACAA 300
AACCCGTACC ACTAAAAGCG AATCATCGAC TTGATAAACT AAGGTGGTCT TGTGTATGTT

ACAGAAAAGA GCCAGACATG AACAAAGTCA AGCTTTTCTC AACAGTTGCC CATGGAAACA 360
TGCTTTTCT CGGTCTGTAC TTGTTTCAGT TCGAAAAGAG TTGTCAACGG GTACCTTTGT

AAAGTGCAAG AAGAAAAGCT TACAATGGTT CTAGAAGGAA TATTTTCTCT CGCCGTCTCT 420
TTTCACGTTT TTCTTTTCGA ATGTTACCAA GATCTTCCTT ATAAAAAGGA GCGGCAAGAA

TTGATAAAG AAATACAGAG GTTACTGAAA AGCCTGGTGC CAAGATGTTT TGGAAACAATT 480
AACTATTTTC TTTATGTCTC CAATGACTTT TCGGACCACG GTTCTACAAG ACCTTGTTAA

TTTTGGTTAA AATGAATGGA GCCCCACAGA ATACAAGCCA TGGCAGTAAA GCACAGGAAA 540
AAAACCAATT TTACTTACCT CGGGGTGTCT TATGTTCGGT ACCGTCATTT CGTGTCTTT

TAATGAAAGA AGCTTGCAAA ACCTTGTTTT TCACTCAGAA TATTGTACAT GAAAAGTGTG 600
ATTACTTTCT TCGAACGTTT TGGAACAAAA AGTGAGTCTT ATAACATGTA CTTTGTGACAC

ACAGGATGGT GATACAGAAC AATCTGTGCT TTGGTAAATG CATCTCTCTC CATGTTCCAA 660
TGTCCTACCA CTATGTCTTG TTAGACACGA AACCATTAC GTAGAGAGAG GTACAAGGTT

ATCAGCAAGA TCGACGAAAT ACTTGTCCC ATTGCTTGCC GTCCAAATTT ACCCTGAACC 720
TAGTCGTTCT AGCTGCTTTA TGAACAAGGG TAACGAACGG CAGGTTTAAA TGGGACTTGG

ACCTGACGCT GAATTGTACT GGATCTAAGA ATGTAGTAAA GGTGTGTCATG ATGGTAGAGG 780
TGGACTGCGA CTTAACATGA CCTAGATTCT TACATCATTT CCAACAGTAC TACCATCTCC

AATGCACGTG TGAAGCTCAT AAGAGCAACT TCCACCAAAC TGCACAGTTT AACATGGATA 840
TTACGTGCAC ACTTCGAGTA TTCTCGTTGA AGGTGGTTTG ACGTGTCAA TGTACCTAT

CATCTACTAC CCTGCACCAT TAAAGGACTG CCATACAGTA TGGAAATGCC CTTTGTGTTG 900
GTAGATGATG GGACGTGGTA ATTTCTGAC GGTATGTCAT ACCTTTACGG GAAAACAACC

AATATTTGTT ACATACTATG CATCTAAAGC ATTATGTTGC CTTCTATTTT ATATAACCAC 960
TTATAACAA TGTATGATAC GTAGATTTTC TAATACAACG GAAGATAAAG TATATTGGTG

ATGGAATAAG GATTGTATGA ATTATAATTA ACAAATGGCA TTTTGTGTAA CATGCAAGAT 1020
TACCTTATTC CTAACATACT TAATATTAAT TGTTTACCGT AAAACACATT GTACGTTCTA

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CTCTGTTCCA	TCAGTTGCAA	GATAAAAGGC	AATATTTGTT	TGACTTTTTT	TCTACAAAAT	1080
GAGACAAGGT	AGTCAACGTT	CTATTTTCCG	TTATAAACAA	ACTGAAAAAA	AGATGTTTTA	
GAATACCCAA	ATATATGATA	AGATAATGGG	GTCAAAACTG	TTAAGGGGTA	ATGTAATAAT	1140
CTTATGGGTT	TATATACTAT	TCTATTACCC	CAGTTTTGAC	AATTCCCCAT	TACATTATTA	
AGGGACTAAG	TTTGCCCAGG	AGCAGTGACC	CATAACAACC	AATCAGCAGG	TATGATTTAC	1200
TCCCTGATTG	AAACGGGTCC	TCGTCACTGG	GTATTGTTGG	TTAGTCGTCC	ATACTAAATG	
TGGTCACCTG	TTTAAAAGCA	AACATCTTAT	TGGTTGCTAT	GGGTTACTGC	TTCTGGGCAA	1260
ACCAGTGGAC	AAATTTTCGT	TTGTAGAATA	ACCAACGATA	CCCAATGACG	AAGACCCGTT	
AATGTGTGCC	TCATAGGGGG	GTTAGTGTGT	TGTGTACTGA	ATAAATTGTA	TTTATTTTCAT	1320
TTACACACGG	AGTATCCCCC	CAATCACACA	ACACATGACT	TATTTAACAT	AAATAAAGTA	
TGTTACAAAA	AAAAAAA					
ACAATGTTTT	TTTTTTTT					

Fig. 2. (Continuation page 2, SEQ ID NO:2).

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MSRTRKVD	SL	LLLAIPGLAL	LLLPNAYCAS	CEPVRIPMCK	SMPWNMTKMP	NHLHHSTQAN	60
AILAIEQFEG	LLTTECSQDL	LFFLCAMYAP	ICTIDFQHEP	IKPCKSV CER	ARAGCEPILI		120
KYRHTWPESL	ACEELPVYDR	GVCISPEAIV	TVEQGTDSMP	DFSMDSNNGN	CGSGREHCKC		180
KPMKATQKTY	LKNYNYVIR	AKVKEVKVVC	HDATAIVEVK	EILKSSLVNI	PKDTVTLYTN		240
SGCLCPQLVA	NEEYIIMGYE	DKERTRLLLV	EGSLAEKWRD	RLAKKVWRD	QKLRRPRKSK		300
DPVAPIPNKN	SNSRQARS						

Figure 3. Deduced amino acid sequence of Xenopus frazzled protein. SEQ ID NO:3.

0903325.07101

Figure 4. Nucleotide sequence of the full-length frazzled cDNA derived from the *Xenopus* organizer. The sense strand of the DNA on top (5' to 3' direction) and the antisense strand on the bottom line (opposite direction). SEQ ID NO:4.

GAATTCCTT TCACACAGGA CTCCTGGCAG AGGTGAATGG TTAGCCCTAT GGATTTGGTT	60
CTTAAGGGAA AGTGTGTCCT GAGGACCGTC TCCACTTACC AATCGGGATA CCTAAACCAA	
TGTTGATTTT GACACATGAT TGATTGCTTT CAGATAGGAT TGAAGGACTT GGATTTTAT	120
ACAACTAAAA CTGTGTACTA ACTAACGAAA GTCTATCCTA ACTTCCTGAA CCTAAAAATA	
CTAATCTGC ACTTTTAAAT TATCTGAGTA ATTGTTTATT TTGTATTGGA TGGGACTAAA	180
GATTAAGACG TGAAAATTTA ATAGACTCAT TAACAAGTAA AACATAACCT ACCCTGATTT	
GATAAACTTA ACTCCTTGCT TTTGACTTGC CCATAAACTA TAAGGTGGGG TGAGTTGTAG	240
CTATTTGAAT TGAGGAACGA AACTGAACG GGTATTTGAT ATTCCACCCC ACTCAACATC	
TTGCTTTTAC ATGTGCCAG ATTTCCCTG TATTCCTGT ATTCCCTCTA AAGTAAGCCT	300
AACGAAAATG TACACGGGTC TAAAGGGAC ATAAGGGACA TAAGGGAGAT TTCATTTCGA	
ACACATACAG GTTGGGCAGA ATAACAATGT CTCGAACAAG GAAAGTGGAC TCATTACTGC	360
TGTGTATGTC CAACCCGTCT TATTGTTACA GAGCTTGTTT CTTTCACCTG AGTAATGACG	
TACTGGCCAT ACCTGGACTG GCGCTTCTCT TATTACCCAA TGCTTACTGT GCTTCGTGTG	420
ATGACCGGTA TGGACCTGAC CGCGAAGAGA ATAATGGGTT ACGAATGACA CGAAGCACAC	
AGCCTGTGCG GATCCCATG TGCAAATCTA TGCCATGGAA CATGACCAAG ATGCCCAACC	480
TCGGACACGC CTAGGGGTAC ACGTTTAGAT ACGGTACCTT GTACTGGTTC TACGGGTTGG	
ATCTCCACCA CAGCACTCAA GCCAATGCCA TCCTGGCAAT TGAACAGTTT GAAGGTTTGC	540
TAGAGGTGGT GTCGTGAGTT CGGTTACGGT AGGACCGTTA ACTTGTCAA CTTCCAAACG	
TGACCACTGA ATGTAGCCAG GACCTTTTGT TCTTCTGTG TGCCATGTAT GCCCCATTT	600
ACTGGTGACT TACATCGGTC CTGGAAAACA AGAAGACAC ACGGTACATA CGGGGGTAAA	
GTACCATCGA TTTCCAGCAT GAACCAATTA AGCCTTGCAA GTCCGTGTGC GAAAGGGCCA	660
CATGGTAGCT AAAGTTCGTA CTTGGTTAAT TCGGAACGTT CAGGCACACG CTTTCCGGT	
GGGCCGGCTG TGAGCCCAT CTCTAAAAGT ACCGGCACAC TTGGCCAGAG AGCCTGGCAT	720
CCCGGCCGAC ACTCGGGTAA GAGTATTTCA TGGCCGTGTG AACCAGGTCTC TCGGACCGTA	
GTGAAGAGCT GCGCGTATAT GACAGAGGAG TCTGCATCTC CCCAGAGGCT ATCGTCACAG	780
CACTTCTCGA CGGGCATATA CTGTCTCCTC AGACGTAGAG GGGTCTCCGA TAGCAGTGTC	
TGGAACAAGG AACAGATTCA ATGCCAGACT TCTCCATGGA TTCAAACAAT GGAAATTGCG	840
ACCTTGTTCC TTGTCTAAGT TACGGTCTGA AGAGGTACCT AAGTTTGTTA CCTTTAACGC	
GAAGCGGCAG GGAGCACTGT AAATGCAAGC CCATGAAGGC AACCCAAAAG ACGTATCTCA	900
CTTCGCGGTC CCTCGTGACA TTTACGTTCT GGTACTTCCG TTGGGTTTTT TGCATAGAGT	
AGAATAATTA CAATTATGTA ATCAGAGCAA AAGTGAAAGA GGTGAAAGTG AAATGCCACG	960
TCTTATTAAT GTTAATACAT TAGTCTCGTT TTCACTTTCT CCACTTTTAC TTTACGGTGC	
ACGCAACAGC AATTGTGGAA GTAAAGGAGA TTCTCAAGTC TTCCCTAGTG AACATTCTTA	1020
TGCGTTGTCTG TTAACACCTT CATTTCTCT AAGAGTTCAG AAGGGATCAC TTGTAAGGAT	

MLLLFRAIPM LLLGLMVLQT DCEIAQYYID EEEPPGTVIA VLSQHSIFNT TDIPATNFRL 60
 MKQFNNSLIG VRESQGQLSI MERIDREQIC RQSLHCNLAL DVVSFSKGF KLLNVKVEVR 120
 DINDHSPHFP SEIMHVEVSE SSSVGTRIPL EIAIDEDVGS NSIQNFQISN NSHFSIDVLT 180
 RADGVKYADL VLMRELDREI QPTYIMELLA MDGGVPSLSG TAVVNIRVLD FNDNSPVFER 240
 STIAVDLVED APLGYLLEL HATDDDEGVN GEIVYGFSTL ASQEVRLFK INSRTGSVTL 300
 EGQVDFETKQ TYEFEVQAQD LGPNELTATC KVTVHILDVN DNTPAITITP LTTVNAGVAY 360
 IPETATKENF IALISTTDRA SGSNGQVRCT LYGHEHFKLQ QAYEDSYMIV TTSTLDRENI 420
 AAYSLTVVAE DLGFPSLTKK KYITVKVSDE NDNAPVFSKP QYEASILENN APGSYITTVI 480
 ARDSDSDQNG KVNRYLVDK VMGQSLTTFV SLDADSGVLR AVRSLDYEKL KQLDFEIEAA 540
 DNGIPQLSTR VQLNLRIVDQ NDNCPVITNP LLNNGSGEVL LPISAPQNYL VFQLKAEDSD 600
 EGHNSQLFYT ILRDPSRLFA INKESGEVFL KKQLNSDHSE DLSIVVAVYD LGRPSLSTNA 660
 TVKFILTDSE PSNVEVVILQ PSAEEHQID MSIIFIAVLA GGCALLLLAI FVACTCKKK 720
 AGEFKQVPEQ HGTCNEERLL STSPQSVSS SLSQSESCQL SINTESENCV VSSNQEQHQQ 780
 TGIKHSISVP SYHTSGWHLN NCAMSISGHS HMGHISTKVQ WAKEIVTSMT VTLILVENQK 840
 RRALSSQCRH KPVLTQMNQ QGSDMPITIS ATESTRVQKM GTAHCNMKRA IDCLTL

Figure 5. Deduced amino acid sequence of the *Xenopus* PAPC (paraxial protocadherin) protein. It encodes a member of the cadherin family of transmembrane proteins that has dorsalizing activity when constructs are injected into *Xenopus* embryos. SEQ ID NO:5.

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Figure 6. Nucleotide sequence of the full-length PAPC cDNA derived from the *Xenopus* organizer. The sense strand of the DNA is shown in the top line (in the 5' to 3' direction), and the bottom line shows the antisense strand (opposite orientation). SEQ ID NO:6.

GAATTCCCAG AGATGAACTC CTTGAGATTG TTTTAAATGA CTGCAGGTCT GGAAGGATTC 60
CTTAAGGGTC TCTACTTGAG GAACTCTAAC AAAATTTACT GACGTCCAGA CCTTCCTAAG

ACATTGCCAC ACTGTTTCTA GGCATGAAAA AACTGCAAGT TTCAACTTTG TTTTGGTG 120
TGTAACGGTG TGACAAAGAT CCGTACTTTT TTGACGTTCA AAGTTGAAAC AAAAACCACG

AACTTTGATT CTTCAAGATG CTGCTTCTCT TCAGAGCCAT TCCAATGCTG CTGTTGGGAC 180
TTGAAACTAA GAAGTTCTAC GACGAAGAGA AGTCTCGGTA AGGTACGAC GACAACCCTG

TGATGGTTTT ACAAACAGAC TGTGAAATTG CCCAGTACTA CATAGATGAA GAAGAACCCC 240
ACTACCAAAA TGTTTGCTG ACACTTTAAAC GGGTCATGAT GTATCTACTT CTTCTTGGGG

CTGGCACTGT AATTGCAGTG TTGTCACAAC ACTCCATATT TAACACTACA GATATACCTG 300
GACCGTGACA TTAACGTCAC AACAGTGTG TGAGGTATAA ATTGTGATGT CTATATGGAC

CAACCAATTT CCGTCTAATG AAGCAATTTA ATAATTCCTT TATCGGAGTC CGTGAGAGTG 360
GTTGGTTAAA GGCAGATTAC TTCGTTAAAT TATTAAGGGA ATAGCCTCAG GCACTCTCAC

ATGGGCAGCT GAGCATCATG GAGAGGATTG ACCGGGAGCA AATCTGCAGG CAGTCCCTTC 420
TACCCGTCGA CTCGTAGTAC CTCTCCTAAC TGGCCCTCGT TTAGACGTCC GTCAGGGAAG

ACTGCAACCT GGCTTTGGAT GTGGTCAGCT TTTCCAAAGG AACTTCAAG CTTCTGAACG 480
TGACGTTGGA CCGAAACCTA CACCACTCGA AAAGGTTTCC TGTGAAGTTC GAAGACTTGC

TGAAAGTGGA GGTGAGAGAC ATTAATGACC ATAGCCCTCA CTTTCCAGT GAAATAATGC 540
ACTTTCACCT CCACTCTCTG TAATTACTGG TATCGGGAGT GAAAGGGTCA CTTTATTACG

ATGTGGAGGT GTCTGAAAGT TCCTCTGTGG GCACCAGGAT TCCTTTAGAA ATTGCAATAG 600
TACACCTCCA CAGACTTTC AAGAGACACC CGTGGTCCTA AGGAAATCTT TAACGTTATC

ATGAAGATGT TGGGTCCAAC TCCATCCAGA ACTTTCAGAT CTCAAATAAT AGCCACTTCA 660
TACTTCTACA ACCCAGGTTG AGGTAGGTCT TGAAAGTCTA GAGTTTATTA TCGGTGAAGT

GCATTGATGT GCTAACCAGA GCAGATGGGG TGAAATATGC AGATTTAGTC TTAATGAGAG 720
CGTAACTACA CGATTGGTCT CGTCTACCCC ACTTTATACG TCTAAATCAG AATTACTCTC

AACTGGACAG GGAAATCCAG CCAACATACA TAATGGAGCT ACTAGCAATG GATGGGGGTG 780
TTGACCTGTC CCTTTAGGTC GGTGTATGT ATTACCTCGA TGATCGTTAC CTACCCCCAC

TACCATCACT ATCTGGTACT GCAGTGGTTA ACATCCGAGT CCTGGACTTT AATGATAACA 840
ATGGTAGTGA TAGACCATGA CGTCACCAAT TGTAGGCTCA GGACCTGAAA TTACTATTGT

GCCCAGTGTT TGAGAGAAGC ACCATTGCTG TGGACCTAGT AGAGGATGCT CCTCTGGGAT 900
CGGGTCACAA ACTCTCTTCG TGTAACGAC ACCTGGATCA TCTCCTACGA GGAGACCCTA

ACCTTTTGTT GGAGTTACAT GCTACTGACG ATGATGAAGG AGTGAATGGA GAAATTGTTT 960
TGGAAAACAA CCTCAATGTA CGATGACTGC TACTACTTCC TCACTTACCT CTTTAACAAA

ATGGATTGAG CACTTTGGCA TCTCAAGAGG TACGTCAGCT ATTTAAAATT AACTCCAGAA 1020
TACCTAAGTC GTGAAACCGT AGAGTTCTCC ATGCAGTCGA TAAATTTTAA TTGAGGTCTT

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AAGTCGTTAT TTTGCAACCA TCTGCAGAAG AGCAGCACCA GATCGATATG TCCATTATAT	2220
TTCAGCAATA AAACGTTGGT AGACGTCTTC TCGTCGTGGT CTAGCTATAC AGGTAATATA	
TCATTGCAGT GCTGGCTGGT GGTGTGCTT TGCTACTTTT GGCCATCTTT TTTGTGGCCT	2280
AGTAACGTCA CGACCGACCA CCAACACGAA ACGATGAAA CCGGTAGAAA AAACACCGGA	
GTACTTGTA AAGAAAGCT GGTGAATTTA AGCAGGTACC TGAACAACAC GGAACATGCA	2340
CATGAACATT TTTCTTTCGA CCACTTAAAT TCGTCCATGG ACTTGTTGTG CTTGTACGT	
ATGAAGAACG CCTGTTAAGC ACCCATCTC CCCAGTCGGT CTCTTCTTCT TTGTCTCAGT	2400
TACTTCTTGC GGACAATTCTG TGGGGTAGAG GGGTCAGCCA GAGAAGAAGA AACAGAGTCA	
CTGAGTCATG CCAACTCTCC ATCAATACTG AATCTGAGAA TTGCAGCGTG TCCTCTAACC	2460
GACTCAGTAC GGTGAGAGG TAGTTATGAC TTAGACTCTT AACGTCGCAC AGGAGATTGG	
AAGAGCAGCA TCAGCAAACA GGCATAAAGC ACTCCATCTC TGTACCATCT TATCACACAT	2520
TTCTCGTCGT AGTCGTTTGT CCGTATTTCTG TGAGGTAGAG ACATGGTAGA ATAGTGTGTA	
CTGGTTGGCA CCTGGACAAT TGTGCAATGA GCATAAGTGG ACATTCTCAC ATGGGGCACA	2580
GACCAACCGT GGACCTGTGA ACACGTTACT CGTATTCACC TGTAAGAGTG TACCCCGTGT	
TTAGTACAAA GGTACAGTGG GCAAAGGAGA TAGTGACTTC AATGACAGTG ACTCTGATAC	2640
AATCATGTTT CCATGTCACC CGTTTCCTCT ATCACTGAAG TTAGTGTCAC TGAGACTATG	
TAGTGGAGAA TCAGAAAAGA AGAGCATTGA GCAGCCAATG CAGGCACAAG CCAGTGCTCA	2700
ATCACCTCTT AGTCTTTTCT TCTCGTAACT CGTCGGTTAC GTCCGTGTTT GGTACAGAGT	
ATACACAGAT GAATCAGCAG GGTTCGACA TGCCGATAAC TATTTTCAGCC ACCGAATCAA	2760
TATGTGTCTA CTTAGTCGTC CCAAGGCTGT ACGGCTATTG ATAAAGTCGG TGGCTTAGTT	
CAAGGGTCCA GAAAATGGGA ACTGCACATT GCAATATGAA AAGGGCTATA GACTGTCTTA	2820
GTTCCAGGT CTTTACCCT TGACGTGTAA CGTTATACTT TTCCCGATAT CTGACAGAAT	
CTCTGTAGCT CCTGTATATT ACAATACCTA CCATGCAAGA ATGCCTAACC TGCACATACC	2880
GAGACATCGA GGACATATAA TGTTATGGAT GGTACGTTCT TACGGATTGG ACGTGTATGG	
GAACCATACC CTTAGAGACC CTTATTACCA TATCAATAAT CCTGTTGCTA ATCGGATGCA	2940
CTTGGTATGG GAATCTCTGG GAATAATGGT ATAGTTATTA GGACAACGAT TAGCCTACGT	
GGCGGAATAT GAAAGAGATT TAGTCAACAG AAGTGCAACG TTATCTCCGC AGAGATCGTC	3000
CCGCCTTATA CTTTCTCTAA ATCAGTTGTC TTCACGTTGC AATAGAGGCG TCTCTAGCAG	
TAGCAGATAC CAAGAATTCA ATTACAGTCC GCAGATATCA AGACAGCTTC ATCCTTCAGA	3060
ATCGTCTATG GTTCTTAAGT TAATGTCAGG CGTCTATAGT TCTGTGGAAG TAGGAAGTCT	
AATTGCTACA ACCTTTTAAT CATTAGGCAT GCAAGTGAGA ATGCACAAAG GCAAGTGCTT	3120
TTAACGATGT TGGAAAATTA GTAATCCGTA CGTTCACTCT TACGTGTTTC CGTTCACGAA	
TAGCATGAAA GCTAAATATA TGGAGTCTCC CCTTCCCTC TGATGGATGG GGGGAGACAC	3180
ATCGTACTTT CGATTTATAT ACCTCAGAGG GGAAAGGGAG ACTACCTACC CCCCTCTGTG	
AGGACAGTGC ATAAATATAC AGCTGCTTTC TATTTGCATT TCACTTGGGA ATTTTTTGT	3240
TCCTGTCACG TATTTATATG TCGACGAAAG ATAAACGTAA AGTGAACCCCT TAAAAACAA	
TTTTTTACAT ATTTATTTTT CCTGAATTGA ATGTGACATT GTCCTGTCAC CTAAGTAGCA	3300
AAAAATGTA TAAATAAAAA GGACTTAACT TACACTGTAA CAGGACAGTG GATTGATCGT	

Fig. 6. (Continuation page 3, SEQ ID NO:6).

ATTAAATCCA	CAGACCTACA	GTCAAATATT	TGAGGGCCCC	TGAAACAGCA	CATCAGTCAG	3360
TAATTTAGGT	GTCTGGATGT	CAGTTTATAA	ACTCCCGGGG	ACTTTGTCGT	GTAGTCAGTC	
GACCTAAAGT	GGCCTTTTTA	CTTTTAGCAG	CTCCTGGGTC	TGCCCTCTGT	GTTAATCAGC	3420
CTGGATTTC	CCGGAATAAT	GAAATCGTC	GAGGACCCAG	ACGGGAGACA	CAATTAGTCG	
CCCTGGTCAA	GTCTGAGTA	GGATCATGGC	GTTTTATAT	GCATCTCACC	TACTTTGGAC	3480
GGGACCAGTT	CAGGACTCAT	CCTAGTACCG	CAAAATATA	CGTAGAGTGG	ATGAAACCTG	
GTGATTTACA	CATAATAGGA	AACGCTTGGT	TTCAGTGAAG	TCTGTGTTGT	ATATATTCTG	3540
CACTAAATGT	GTATTATCCT	TTGCGAACCA	AAGTCACTTC	AGACACAACA	TATATAAGAC	
TTATATACAC	GCATTTTGTG	TTTGTGTATA	TATTTCAAGT	CCATTCAGAT	ATGTGTATAT	3600
AATATATGTG	CGTAAACAC	AAACACATAT	ATAAAGTTCA	GGTAAGTCTA	TACACATATA	
AGTGCAGACC	TTGTAAATTA	AATATTCTGA	TACTTTTCC	TCAATAAATA	TTTAAAT	
TCACGTCTGG	AACATTTAAT	TTATAAGACT	ATGAAAAGG	AGTTATTTAT	AAATTTA	

Fig. 6. (Continuation page 4, SEQ ID NO:6).

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MVCCGPGRML LGWAGLLVLA ALCLLQVPGA QAAACEPVRI PLCKSLPWNM TKMPNHLHHS	60
TQANAILAME QFEGLLGTHC SPDLLFFLCA MYAPICTIDF QHEPIKPCKS VCERARQGCE	120
PILIKYRHSW PESLACDELP VYDRGVCISP EAIVTADGAD FPMDSSSTGHC RGASSERCKC	180
KPV RATQKTY FRNNYNYVIR AKVKEVKMKC HDVTAVVEVK EILKASLVNI PRDTVNLYTT	240
SGCLCPPLTV NEEYVIMGYE DEERSRLLLV EGSIAEKWKD RLGKKVKRWD MKLRHLGLGK	300
TDASDSTQNQ KSGRNSNPRP ARS.	

Figure 7. Deduced amino acid sequence of mouse FRZB-1 protein. SEQ ID NO:7.

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Figure 8. Nucleotide sequence of the full-length mouse FRZB-1 cDNA. SEQ ID NO:8.

AAGCCTGGGA CCATGGTCTG CTGCGGCCCG GGACGGATGC TGCTAGGATG GGCCGGGTTG 60
 TTCGGACCCT GGTACCAGAC GACGCCGGGC CCTGCCTACG ACGATCCTAC CCGGCCCAAC
 CTAGTCCTGG CTGCTCTCTG CCTGCTCCAG GTGCCCCGAG CTCAGGCTGC AGCCTGTGAG 120
 GATCAGGACC GACGAGAGAC GGACGAGGTC CACGGGCCTC GAGTCCGACG TCGGACACTC
 CCTGTCCGCA TCCCGCTGTG CAAGTCCCTT CCCTGGAACA TGACCAAGAT GCCCAACCAC 180
 GGACAGGCGT AGGGCGACAC GTTCAGGGAA GGGACCTTGT ACTGGTTCTA CGGGTGTTG
 CTGCACCACA GCACCCAGGC TAACGCCATC CTGGCCATGG AACAGTTCGA AGGGCTGCTG 240
 GACGTGGTGT CGTGGGTCCG ATTGCGGTAG GACCGGTACC TTGTCAAGCT TCCCGACGAC
 GGCACCCACT GCAGCCCGGA TCTTCTCTTC TTCTCTGTG CAATGTACGC ACCCATTTGC 300
 CCGTGGGTGA CGTCGGGCCT AGAAGAGAAG AAGGAGACAC GTTACATGCG TGGGTAAACG
 ACCATCGACT TCCAGCACGA GCCCATCAAG CCCTGCAAGT CTGTGTGTGA GCGCGCCCGA 360
 TGGTAGCTGA AGGTCGTGCT CGGGTAGTTC GGGACGTTCA GACACACACT CGCGCGGGCT
 CAGGGCTGCG AGCCCATTTCT CATCAAGTAC CGCCACTCGT GGCCGGAAG CTTGGCCTGC 420
 GTCCCGACGC TCGGGTAAGA GTAGTTCATG GCGGTGAGCA CCGGCCTTTC GAACCGGACG
 GACGAGCTGC CGGTGTACGA CCGCGGCGTG TGCATCTCTC CTGAGGCCAT CGTCACCGCG 480
 CTGCTCGACG GCCACATGCT GGCGCCGCAC ACGTAGAGAG GACTCCGGTA GCAGTGGCGC
 GACGGAGCGG ATTTTCCTAT GGATTCAAGT ACTGGACACT GCAGAGGGGC AAGCAGCGAA 540
 CTGCCTCGCC TAAAGGATA CCTAAGTTC TGACCTGTGA CGTCTCCCCG TTCGTCGCTT
 CGTTGCAAAT GTAAGCCTGT CAGAGCTACA CAGAAGACCT ATTTCCGGAA CAATTACAAC 600
 GCAACGTTTA CATTCCGACA GTCTCGATGT GTCTTCTGGA TAAAGGCCTT GTTAATGTTG
 TATGTCATCC GGGCTAAAGT TAAAGAGGTA AAGATGAAAT GTCATGATGT GACCGCCGTT 660
 ATACAGTAGG CCCGATTTC ATTTCTCCAT TTCTACTTTA CAGTACTACA CTGGCGGCAA
 GTGGAAGTGA AGGAAATTCT AAAGGCATCA CTGGTAAACA TTCCAAGGGA CACCGTCAAT 720
 CACCTTCACT TCCTTTAAGA TTCCGTTAGT GACCATTGTG AAGGTTCCCT GTGGCAGTTA
 CTTTATACCA CCTCTGGCTG CCTCTGTCCT CCACTTACTG TCAATGAGGA ATATGTCATC 780
 GAAATATGGT GGAGACCGAC GGAGACAGGA GGTGAATGAC AGTTACTCCT TATACAGTAG
 ATGGGCTATG AAGACGAGGA ACGTTCCAGG TTA CTCTTGG TAGAAGGCTC TATAGCTGAG 840
 TACCCGATAC TTCTGCTCCT TGCAAGGTCC AATGAGAACC ATCTTCCGAG ATATCGACTC
 AAGTGGAAGG ATCGGCTTGG TAAGAAAGTC AAGCGCTGGG ATATGAACT CCGACACCTT 900
 TTCACCTTCC TAGCCGAACC ATTCTTTCAG TTCGCGACCC TATACTTTGA GGCTGTGGAA
 GGA CTGGGTA AACTGATGC TAGCGATTCC ACTCAGAATC AGAAGTCTGG CAGGAACTCT 960
 CCTGACCCAT TTTGACTACG ATCGCTAAGG TGAGTCTTAG TCTTCAGACC GTCCTTGAGA

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AATCCCCGGC	CAGCACGCAG	CTAAATCCTG	AAATGTAAAA	GGCCACACCC	ACGGACTCCC	1020
TTAGGGGGCCG	GTCGTGCGTC	GATTTAGGAC	TTTACATTTT	CCGGTGTGGG	TGCCTGAGGG	
TTCTAAGACT	GGCGCTGGTG	GACTAACAAA	GGAAAACCGC	ACAGTTGTGC	TCGTGACCGA	1080
AAGATTCTGA	CCGCGACCAC	CTGATTGTTT	CCTTTTGGCG	TGTCAACACG	AGCACTGGCT	
TTGTTTACCG	CAGACACCGC	GTGGCTACCG	AAGTTACTTC	CGGTCCCCTT	TCTCCTGCTT	1140
AACAAATGGC	GTCTGTGGCG	CACCGATGGC	TTCAATGAAG	GCCAGGGGAA	AGAGGACGAA	
CTTAATGGCG	TGGGGTTAGA	TCCTTTAATA	TGTTATATAT	TCTGTTTCAT	CAATCACGTG	1200
GAATTACCGC	ACCCCAATCT	AGGAAATTAT	ACAATATATA	AGACAAAGTA	GTTAGTGCAC	
GGGACTGTTC	TTTTGCAACC	AGAATAGTAA	ATTAAATATG	TTGATGCTAA	GGTTTCTGTA	1260
CCCTGACAAG	AAAACGTTGG	TCTTATCATT	TAATTTATAC	AACTACGATT	CCAAAGACAT	
CTGGACTCCC	TGGGTTTAAT	TTGGTGTTC	GTACCCTGAT	TGAGAATGCA	ATGTTTCATG	1320
GACCTGAGGG	ACCCAAATTA	AACCACAAGA	CATGGGACTA	ACTCTTACGT	TACAAAGTAC	
TAAAGAGAGA	ATCCTGGTCA	TATCTCAAGA	ACTAGATATT	GCTGTAAGAC	AGCCTCTGCT	1380
ATTTCTCTCT	TAGGACCAGT	ATAGAGTTCT	TGATCTATAA	CGACATTCTG	TCGGAGACGA	
GCTGCGCTTA	TAGTCTTGTC	TTTGATGCC	TTTGTCCATT	TCCCTCATGC	TGTGAAAGTT	1440
CGACGCGAAT	ATCAGAACAC	AAACATACGG	AAACAGGTAA	AGGGAGTACG	ACACTTTCAA	
ATACATGTTT	ATAAAGGTAG	AACGGCATT	TGAAATCAGA	CACTGCACAA	GCAGAGTAGC	1500
TATGTACAAA	TATTTCCATC	TTGCCGTAAA	ACTTTAGTCT	GTGACGTGTT	CGTCTCATCG	
CCAACACCAG	GAAGCATTTA	TGAGGAAACG	CCACACAGCA	TGACTTATTT	TCAAGATTGG	1560
GGTTGTGGTC	CTTCGTAAAT	ACTCCTTTGC	GGTGTGTCGT	ACTGAATAAA	AGTTCTAACC	
CAGGCAGCAA	AATAAATAGT	GTTGGGAGCC	AAGAAAAGAA	TATTTTGCCT	GGTTAAGGGG	1620
GTCCGTCGTT	TTATTTATCA	CAACCCTCGG	TTCTTTTCTT	ATAAAACGGA	CCAATTCCCC	
CACACTGGAA	TCAGTAGCCC	TTGAGCCATT	AACAGCAGTG	TTCTTCTGGC	AAGTTTTTGA	1680
GTGTGACCTT	AGTCATCGGG	AACTCGGTAA	TTGTCGTCAC	AAGAAGACCG	TTCAAAAAC	
TTTGTTTATA	AATGTATTCA	CGAGCATTAG	AGATGAACTT	ATAACTAGAC	ATCTGTTGTT	1740
AAACAAGTAT	TTACATAAGT	GCTCGTAATC	TCTACTTGAA	TATTGATCTG	TAGACAACAA	
ATCTCTATAG	CTCTGCTTCC	TTCTAAATCA	AACCCATTGT	TGGATGCTCC	CTCTCCATTTC	1800
TAGAGATATC	GAGACGAAGG	AAGATTTAGT	TTGGGTAACA	ACCTACGAGG	GAGAGGTAAG	

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ATAAATAAAT TTGGCTTGCT GTATTGGCCA GGAAAAGAAA GTATTAAAGT ATGCATGCAT	1860
TATTTATTTA AACCGAACGA CATAACCGGT CCTTTTCTTT CATAATTTCA TACGTACGTA	
GTGCACCAGG GTGTTATTTA ACAGAGGTAT GTAACCTCTAT AAAAGACTAT AATTTACAGG	1920
CACGTGGTCC CACAATAAAT TGTCTCCATA CATTGAGATA TTTTCTGATA TTAAATGTCC	
ACACGGAAAT GTGCACATTT GTTTACTTTT TTTCTTCCTT TTGCTTTGGG CTTGTGATTT	1980
TGTGCCTTTA CACGTGTAAC CAAATGAAAA AAAGAAGGAA AACGAAACCC GAACACTAAA	
TGGTTTTTGG TGTGTTTATG TCTGTATTTT GGGGGGTGGG TAGGTTTAAG CCATTGCACA	2040
ACCAAAAACC ACACAAATAC AGACATAAAA CCCCCACCC ATCCAAATTC GGTAACGTGT	
TTCAAGTTGA ACTAGATTAG AGTAGACTAG GCTCATTGGC CTAGACATTA TGATTTGAAT	2100
AAGTTCAACT TGATCTAATC TCATCTGATC CGAGTAACCG GATCTGTAAT ACTAACTTA	
TTGTGTTGTT TAATGCTCCA TCAAGATGTC TAATAAAAGG AATATGGTTG TCAACAGAGA	2160
AACACAACAA ATTACGAGGT AGTTCTACAG ATTATTTTCC TTATACCAAC AGTTGTCTCT	
CGACAACAAC AACAAA	
GCTGTTGTTG TTGTTT	

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MVCGSPGGML LLRAGLLALA ALCLLRVPGA RAAACEPVRI PLCKSLPWNM TKMPNHLHHS	60
TQANAILAIE QFEGLLGTHC SPDLLFFLCA MYAPICTIDF QHEPIKPCKS VCERARQGCE	120
PILIKYRHSW PENLACEELP VYDRGVCISP EAIVTADGAD FPMDSSNGNC RGASSERCKC	180
KPIRATQKTY FRNNYNYVIR AKVKEIKTKC HDVTAVVEVK EILKSSLVNI PRDTVNLYTS	240
SGCLCPPLNV NEEYIIMGYE DEERSRLLLV EGSIAEKWKD RLGKKVKRWD MKLRHLGLSK	300
SDSSNSDSTQ SQKSGRNSNP RQARN.	

Figure 9. Deduced amino acid sequence of human FRZB-1 protein. SEQ ID NO:9.

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Figure 10. Nucleotide sequence of the full-length human FRZB-1 cDNA. SEQ ID NO:10.
This sequence was assembled from public ESTs from the Genbank database
(accession numbers: H18848, R63748, W38677, W44760, H38379 and N71244).

GGCGGAGCGG GCCTTTTGGC GTCCACTGCG CGGCTGCACC CTGCCCCATC TGCCGGGATC 60
CCGCCTCGCC CGGAAAACCG CAGGTGACGC GCCGACGTGG GACGGGGTAG ACGGCCCTAG
ATGGTCTGCG GCAGCCCGGG AGGGATGCTG CTGCTGCGGG CCGGGCTGCT TGCCCTGGCT 120
TACCAGACGC CGTCGGGCCC TCCCTACGAC GACGACGCCC GGCCCGACGA ACGGGACCGA
GCTCTCTGCC TGCTCCGGGT GCGCGGGGCT CGGGCTGCAG CCTGTGAGCC CGTCCGCATC 180
CGAGAGACGG ACGAGGCCCA CGGGCCCCGA GCCCGACGTC GGACACTCGG GCAGGCGTAG
CCCCTGTGCA AGTCCCTGCC CTGGAACATG ACTAAGATGC CCAACCACCT GCACCACAGC 240
GGGGACACGT TCAGGGACGG GACCTTGTA C TGATTCTACG GGTGTTGTTGA CGTGGTGTCTG
ACTCAGGCCA ACGCCATCCT GGCCATCGAG CAGTTTGAAG GTCTGTCTGGG CACCCACTGC 300
TGAGTCCGGT TCGGGTAGGA CCGGTAGCTC GTCAAGCTTC CAGACGACCC GTGGGTGACG
AGCCCCGATC TGCTCTTCTT CCTCTGTGCC ATGTACGCGC CCATCTGCAC CATTGACTTC 360
TCGGGGCTAG ACGAGAAGAA GGAGACACGG TACATGCGCG GGTAGACGTG GTAACCTGAAG
CAGCACGAGC CCATCAAGCC CTGTAAGTCT GTGTGCGAGC GGGCCCCGCA GGGCTGTGAG 420
GTCGTGCTCG GGTAGTTCGG GACATTCAGA CACACGCTCG CCCGGGCCGT CCCGACACTC
CCCATACTCA TCAAGTACCG CCACTCGTGG CCGGAGAACC TGGCCTGCGA GGAGCTGCCA 480
GGGTATGAGT AGTTCATGGC GGTGAGCACC GGCTCTTGG ACCGGACGCT CCTCGACGGT
GTGTACGACA GGGGCGTGTG CATCTCTCCC GAGGCCATCG TTAGTGCAGG CGGAGCTGAT 540
CACATGCTGT CCGCGCACAC GTAGAGAGGG CTCCGGTAGC AATGACGCCT GCCTCGACTA
TTTCCTATGG ATTCTAGTAA CGGAAACTGT AGAGGGGCAA GCAGTGAACG CTGTAAATGT 600
AAAGGATACC TAAGATCATT GCCTTTGACA TCTCCCGTT CGTCACTTGC GACATTTACA
AAGCCTATTA GAGCTACACA GAAGACCTAT TTCCGGAACA ATTACAATA TGTCATTTCG 660
TTCGGATAAT CTCGATGTGT CTTCTGGATA AAGGCCTTGT TAATGTTGAT ACAGTAAGCC
GCTAAAGTTA AAGAGATAAA GACTAAGTGC CATGATGTGA CTGCAGTAGT GGAGGTGAAG 720
CGATTTCAAT TTCTCTATTT CTGATTCACG GTACTACACT GACGTCATCA CCTCCACTTC
GAGATTCTAA AGTCCTCTCT GGTAAACATT CCACGGGACA CTGTCAACCT CTATACCAGC 780
CTCTAAGATT TCAGGAGAGA CCATTTGTAA GGTGCCCTGT GACAGTTGGA GATATGGTCC
TCTGGCTGCC TCTGCCCTCC ACTTAATGTT AATGAGGAAT ATATCATCAT GGGCTATGAA 840
AGACCGACGG AGACGGGAGG TGAATTACAA TTAATCCTTA TATAGTAGTA CCCGATACTT

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GATGAGGAAC	GTTCCAGATT	ACTCTTGGTG	GAAGGCTCTA	TAGCTGAGAA	GTGGAAGGAT	900
CTACTCCTTG	CAAGGTCTAA	TGAGAACCAC	CTTCCGAGAT	ATCGACTCTT	CACCTTCCTA	
CGACTCGGTA	AAAAAGTTAA	GCGCTGGGAT	ATGAAGCTTC	GTCATCTTGG	ACTCAGTAAA	960
GCTGAGCCAT	TTTTTCAATT	CGCGACCCTA	TACTTCGAAG	CAGTAGAACC	TGAGTCATTT	
AGTGATTCTA	GCAATAGTGA	TTCCACTCAG	AGTCAGAAAGT	CTGGCAGGAA	CTCGAACCCC	1020
TCACTAAGAT	CGTTATCACT	AAGGTGAGTC	TCAGTCTTCA	GACCGTCCTT	GAGCTTGGGG	
CGGCAAGCAC	GCAACTAAAT	CCCGAAATAC	AAAAAGTAAC	ACAGTGGACT	TCCTATTAAAG	1080
GCCGTTCGTG	CGTTGATTTA	GGGCTTTATG	TTTTTCATTG	TGTCACCTGA	AGGATAATTC	
ACTTACTTGC	ATTGCTGGAC	TAGCAAAGGA	AAATTGCACT	ATTGCACATC	ATATTCTATT	1140
TGAATGAACG	TAACGACCTG	ATCGTTTCCT	TTTAACGTGA	TAACGTGTAG	TATAAGATAA	
GTTTACTATA	AAAATCATGT	GATAACTGAT	TATTACTTCT	GTTTCTCTTT	TGGTTTCTGC	1200
CAAATGATAT	TTTTAGTACA	CTATTGACTA	ATAATGAAGA	CAAAGAGAAA	ACCAAAGACG	
TTCTCTCTTC	TCTCAACCCC	TTTGTAATGG	TTTGGGGGCA	GACTCTTAAG	TATATTGTGA	1260
AAGAGAGAAG	AGAGTTGGGG	AAACATTACC	AAACCCCCGT	CTGAGAATTC	ATATAACACT	
GTTTTCTATT	TCACTAATCA	TGAGAAAAAC	TGTTCTTTTG	CAATAATAAT	AAATTAAACA	1320
CAAAGATAA	AGTGATTAGT	ACTCTTTTTG	ACAAGAAAAAC	GTTATTATTA	TTTAATTTGT	
TGCTGTTACC	AGAGCCTCTT	TGCTGAGTCT	CCAGATGTTA	ATTTACTTTT	TGCACCCCCA	1380
ACGACAATGG	TCTCGGAGAA	ACGACTCAGA	GGTCTACAAT	TAAATGAAAG	ACGTGGGGTT	
TTGGGAATGC	AATATTGGAT	GAAAAGAGAG	GTTTCTGGTA	TTACACAGAA	GCTAGATATG	1440
AACCCTTACG	TTATAACCTA	CTTTTCTCTC	CAAAGACCAT	AAGTGTCTTT	CGATCTATAC	
CCTTAAACA	TACTCTGCCG	ATCTAATTAC	AGCCTTATTT	TTGTATGCCT	TTTGGGCATT	1500
GGAATTTTGT	ATGAGACGGC	TAGATTAATG	TCGGAATAAA	AACATACGGA	AAACCCGTAA	
CTCCTCATGC	TTAGAAAGTT	CCAAATGTTT	ATAAAGGTAA	AATGGCAGTT	TGAAGTCAAA	1560
GAGGAGTACG	AATCTTTCAA	GGTTTACAAA	TATTTCCATT	TTACCGTCAA	ACTTCAGTTT	
TGTCACATAG	GCAAAGCAAT	CAAGCACCAG	GAAGTGTTTA	TGAGGAAACA	ACACCCAAGA	1620
ACAGTGTATC	CGTTTCGTTA	GTTTCGTGGT	CTTCACAAAT	ACTCCTTTGT	TGTGGGTTCT	
TGAATTATTT	TTGAGACTGT	CAGGAAGTAA	AATAAATAGG	AGCTTAAGAA	AGAACATTTT	1680
ACTTAATAAA	AACTCTGACA	GTCCTTCATT	TTATTTATCC	TCGAATTCTT	TCTTGTAATA	
GCCTGATTGA	GAAGCACAAC	TGAAACCAGT	AGCCGCTGGG	GTGTTAATGG	TAGCATTCTT	1740
CGGACTAACT	CTTCGTGTTG	ACTTTGGTCA	TCGGCGACCC	CACAATTACC	ATCGTAAGAA	
CTTTTGGCAA	TACATTTGAT	TTGTTCATGA	ATATATTAAT	CAGCATTAGA	GAAATGAATT	1800
GAAAACCGTT	ATGTAAACTA	AACAAGTACT	TATATAATTA	GTCGTAATCT	CTTTACTTAA	
ATAACTAGAC	ATCTGCTGTT	ATCACCATAG	TTTTGTTTAA	TTTGCTTCCT	TTTAAATAAA	1860
TATTGATCTG	TAGACGACAA	TAGTGGTATC	AAAACAAATT	AAACGAAGGA	AAATTTATTT	
CCCATTGGTG	AAAGTCAAAA	AAAAAAAAAA	AAA			
GGGTAACCAC	TTTCAGTTTT	TTTTTTTTTT	TTT			